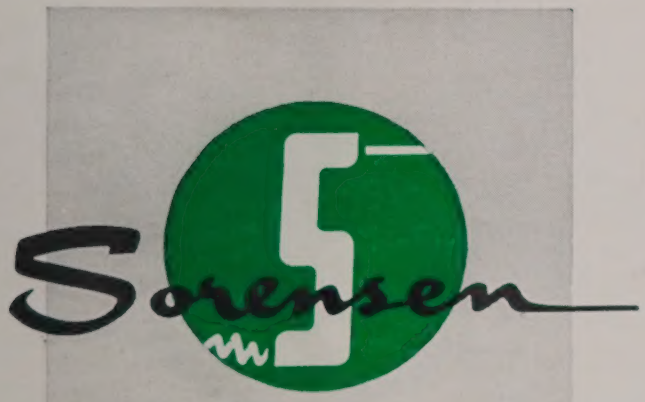
instruction manual

"MR"

NOBATRON RANGERS



Sorensen & Company, inc.

Richards Avenue

South Norwalk, Conn.

GENERAL INFORMATION

PLEASE READ THIS MANUAL. We think it will help you to obtain the maximum performance from your new Sorensen instrument.

SHIPPING DAMAGE

Sometimes instruments are damaged in transit. We strongly suggest that you inspect and test your instrument as soon as you receive it. If the instrument is damaged or if it fails to operate properly, you should ask the carrier to inspect the shipment. The carrier's claim agent will prepare a report of damage which you should send to us. We will then tell you how to have the instrument repaired or replaced.

SERVICE INFORMATION

If you have any questions about the operation, repair, or servicing of a Sorensen instrument, please contact our local representatives. (A list of representatives appears at the rear of this manual.) If it is more convenient you may contact us directly at the Service Department, Sorensen & Co., Inc., Richards Avenue, South Norwalk, Connecticut.

IMPORTANT

BE SURE TO INCLUDE THE MODEL & SERIAL NUMBER IN ALL CORRESPONDENCE CONCERNING THIS INSTRUMENT. WITHOUT THIS INFORMATION WE MAY NOT BE ABLE TO GIVE YOU PROMPT AND ACCURATE SERVICE.

RETURNS TO THE FACTORY

Should you decide to return an instrument to us for repair, please contact us for authorization to make shipment. We have a number of local service facilities in the United States and Canada which are equipped and staffed to provide you with fast, efficient service. For this reason, we reserve the right to refuse unauthorized shipments to our plant.

WARRANTY

This instrument is warranted by Sorensen & Company, Inc., to be free from defects in material and workmanship. Our obligation under the warranty is limited to servicing the instrument and replacing defective parts* when the instrument is returned to the factory with transportation charges prepaid. No other warranties may be implied. The period of warranty is one year after the delivery of the instrument to the original purchaser. Defects caused by improper operating conditions, accidents, misuse, negligence, and the alteration or removal of the nameplate, will void the warranty.

*With the exception of tubes and fuses.

INSTRUCTION MANUAL

"MR"

NOBATRON RANGERS

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SORENSEN & COMPANY, INC., Richards Avenue, South Norwalk, Connecticut

SB14-1732 (F)

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II. SPECIFICATIONS

The Model "MR" Nobatron Rangers are tubeless DC power supplies designed to provide a continuously adjustable output voltage. These instruments use magnetic amplifier circuitry together with a transistorized control circuit containing a silicon diode reference element.

CONDENSED SPECIFICATION CHART

The specifications for the "MR" Nobatron Rangers are listed below in table form. Special notes with further details follow on the next page.

Model		MR36-15	MR36-30	MR150-7.5
Input Voltage		105-125 VAC,	Single Phase,	60 cycles
Input Current (Max.)		15 Amps	30 Amps	30 Amps
Output Voltage		5-36 VDC	5-36 VDC	20-150 VDC
Output Current		0-15 Amps	0-30 Amps	0-7.5 Amps
Regulation Accuracy	Line	± 0.25%		
	Load	± 0.50%		
Ripple (Max.)		1% RMS at maximum output voltage		
Recovery Time		0.2 Seconds		
Transient Excursion (Max.)		6V	6V	25V
Ambient Temperature Range		15°C (61°F) to 35°C (95°F)		
Weight (Net)		100 lbs.	175 lbs.	175 lbs.
Dimensions (Self-Contained)		19-1/8" Wide 12-3/4" High 14-7/8" Deep	19-1/8" Wide 21-1/16" High 14-7/8" Deep	19-1/8" Wide 21-1/16" High 14-7/8" Deep
Input Connection		Line Cord	Terminal Board (Rear)	
Output Connection		Binding Posts (Front Panel) and Terminal Board (Rear)		
Protective Components	Input Fuse	15 Amp	30 Amp	30 Amp
	Overcurrent	Circuit Breaker combined with On-Off Switch		
Meters		Voltmeter and Ammeter Standard		

SPECIFICATIONS - SPECIAL NOTES

Input Frequency

The "MR" Rangers are designed for a nominal input frequency of 60 cps. Operation over the range of 45-65 cps is possible, however, with restrictions on the output voltage range and current rating. In addition the regulation accuracy and ripple specifications will degenerate if the input frequency is other than nominal.

Regulation Accuracy

The regulation accuracy for line changes is defined as $\pm$0.25% against any line change from 105-125VAC, with a fixed load current from zero to full load. The regulation accuracy for load changes is defined as $\pm$0.50% against load changes from no load to full load at any fixed input line voltage from 105-125VAC. Note that regulation accuracy applies to line and load separately, so that if line and load are both changed the total regulation accuracy becomes $\pm$0.75% maximum.

Ripple

The ripple specification is defined as 1% RMS at the maximum output voltage setting, and will increase to 2.5% RMS at the lowest voltage setting. The above specification applies only to 60 cps input frequency, and the ripple will increase to approximately twice this amount if the input frequency is decreased to 45 cps.

Recovery Time

When an abrupt change occurs in the input voltage or load, an instantaneous change occurs in the output voltage. This instantaneous change is quickly suppressed by the regulation action of the instrument. Recovery time is a measure of how fast this change is suppressed. It is defined as the time for the output voltage to effect a 63% recovery from the maximum deviated value based upon a 10% line voltage change or a 50% step change in the load current.

Maximum Transient Excursion

This value, expressed in volts, is the maximum peak voltage above or below the nominal operating level caused by a change of line or load as defined under Recovery Time above.

Ambient Temperature Range

If operation above 35°C (95°F) is attempted, the life of various components may be reduced. In some cases, operation at reduced loads is possible at higher or lower ambients. This is at the discretion and responsibility of the user.

Below 15°C (61°F) the high initial ripple will be decreased as the instrument warms up.

III. INSTALLATION AND OPERATION

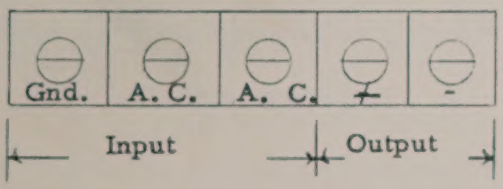
RACK MOUNTING OR BENCH OPERATION

These instruments when originally purchased may be supplied self-contained for bench top operation or equipped for mounting in a standard 19" relay rack. In the event it is later desired to rack mount a self-contained unit or vice versa this may be accomplished without difficulty. The user should contact our local representative or the Sorensen Service Department for the necessary parts and instructions for conversion.

INPUT CONNECTIONS

Model MR36-15 - The input power is applied by means of a line cord that is equipped with a three prong plug. Since the third prong of this plug is attached to the chassis of the instrument, connection of the line cord to a suitable three wire receptacle automatically grounds the instrument. If a three wire receptacle is not available, then a three to two wire adapter should be used. In this case, the third wire from the adapter should be connected to an earth ground or the electrical system ground.

Models MR 36-30 and 150-7.5 - The input power is connected directly to the terminal board located on the rear chassis of the instrument. Upon removing the rear cover, this terminal board will be exposed. A separate ground terminal is provided, and this terminal is connected to the metal chassis for safety grounding.



OUTPUT CONNECTIONS

The DC output of these instruments may be either connected to the binding posts on the front panel, or to the terminal board located at the rear (note drawing above). When making the output connections be sure to observe polarity.

AIR CIRCULATION

Natural convection cooling is employed. The installation must be such that free air circulation is available through the bottom and top of the cabinet. On self-contained units the feet elevate th instrument 1" to provide air access. In rack installations, a similar provision should be made.

CONTROLS

All controls needed for operation are located on the front panel.

On-Off Switch - This switch is both a manual switch and a magnetic trip overcurrent circuit breaker. The switch will trip under short circuit or severe overload conditions.

Output Voltage Adjustment - The output voltage is continuously adjustable by means of the two potentiometer knobs (coarse and fine) located on the front panel.

Meter Range Switch - The Models MR 36-30 & MR 150-7.5 provide a spring-return meter range switch which automatically returns the voltmeter to the highest scale when released. It is used primarily for fine metered adjustment of the output voltage at low voltage settings. CAUTION: NEVER SET THIS SWITCH TO A LOWER SCALE IF THE OUTPUT VOLTAGE SETTING IS ABOVE THE SCALE MAXIMUM. DAMAGE TO THE VOLTMETER MAY RESULT.

Pilot Lamp - Indicates when the input power is on.

METERS

Voltmeter - A triple scale voltmeter is supplied on the Models MR36-30 & MR150-7.5, which is used in conjunction with the meter range switch noted above. A single scale voltmeter is supplied with the Model MR36-15.

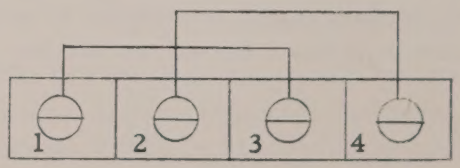
Ammeter - A single scale ammeter is supplied on all models.

REMOTE SENSING

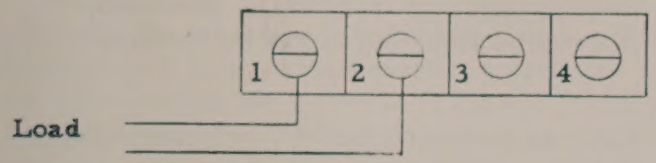
One feature of these Nobatrons is that remote sensing at the load is available. Remote sensing should be used to eliminate the voltage drop occuring in the load connecting wires. This voltage drop, if present, will adversely affect the load regulation.

The connections for remote sensing are located on the terminal board at the rear of the instruments. The Models MR36-30 & MR150-7.5 have separate remote sensing terminal boards, ;while the Model MR36-15 has remote sensing terminals on the same board as the input & output connections.

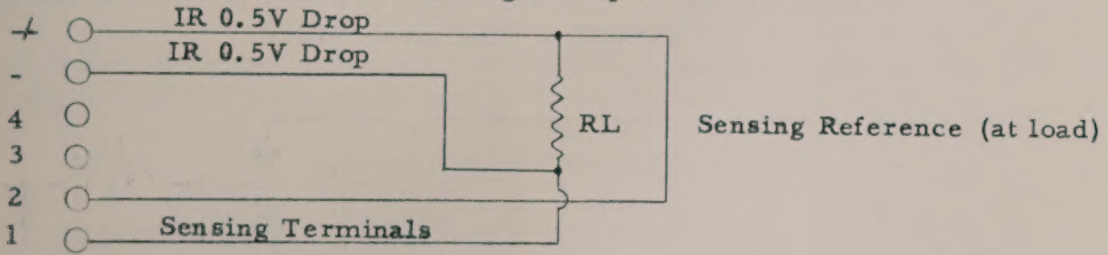
For normal operation (no external sensing) these terminals should be linked as shown:



If remote sensing is desired, the jumpers shown on the previous page should be removed, and the connections to the load made directly to terminals 1 and 2.



A schematic for the full remote sensing hookup is shown below:



IMPORTANT

WHEN REMOTE SENSING BE SURE TO USE HEAVY GAUGE WIRE FROM THE OUTPUT TERMINALS TO THE LOAD. IT IS RECOMMENDED THAT THE VOLTAGE DROP NOT EXCEED 0.5 VOLT PER WIRE. THE SENSING LEADS (TERMINALS 1 & 2 TO LOAD) SHOULD HAVE A TOTAL IR DROP NO GREATER THAN 50 MILLIVOLTS AT 0.5 AMP.

PROTECTIVE DEVICES

Overcurrent Breaker - As noted under Controls, an overcurrent breaker is combined with the On-Off Switch in these instruments. This breaker-switch is a single pole type, thus even when it is in the off position voltages exist at various points within the instrument. It is therefore recommended that the internal circuitry not be touched until the input power has been disconnected externally, either by a line switch or the removal of the input line plug from the power circuit.

CAUTION: OPERATION OF THESE INSTRUMENTS ABOVE THE RATED OUTPUT CURRENT WILL CAUSE OVERHEATING, AND MAY REDUCE THE LIFE OF VARIOUS COMPONENTS.

Input Fuse - An input fuse is provided on the front panel to protect the instrument's circuitry in the event of an internal failure.

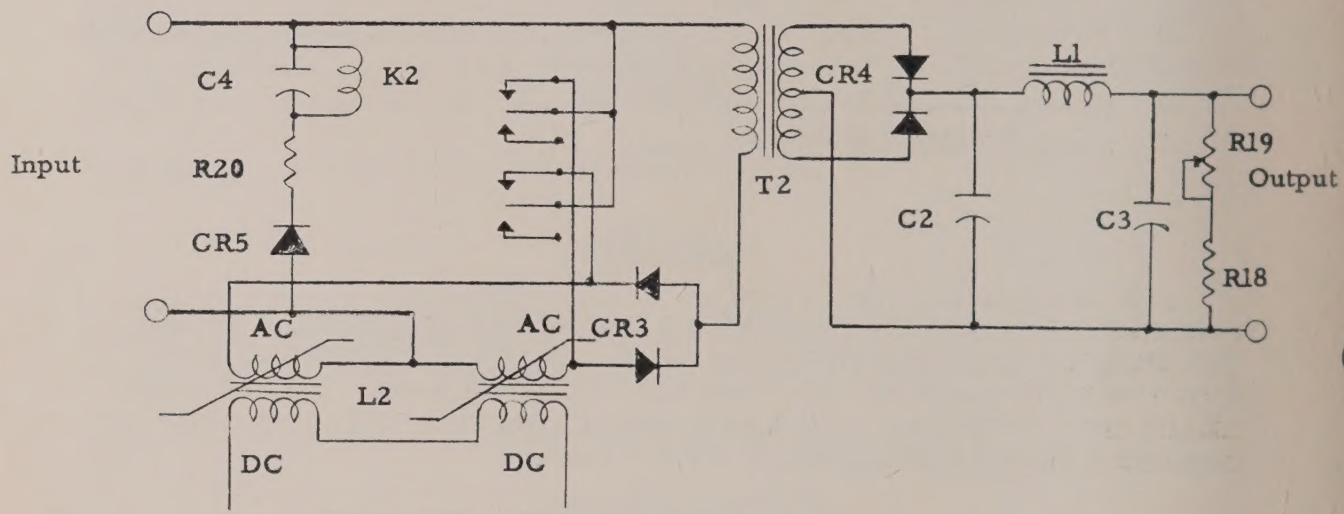
Starting Circuit - A starting circuit is provided in these instrument's to prevent output voltage surges.

IV. PRINCIPLE OF OPERATION

The operation of your instrument can best be understood by referring to the typical schematics shown below. If exact information is required, reference should be made to the schematic included in the Maintenance portion of this manual.

Sorensen Model "MR" Nobatron Rangers employ a power, self-saturating, magnetic amplifier followed by a filter section, together with a transistorized control circuit.

POWER & FILTER CIRCUIT



T2 - Rectifier Input Transformer
L1 - DC Filter Choke
L2 - Self-saturating Magnetic Amplifier
CR3 - Magnetic Amplifier Rectifier
CR4 - Main Power Silicon Rectifier
C2 - Input Filter Capacitance
C3 - Output Filter Capacitance
K2, CR5, C4, & R20 - Starting Circuit - Time Delay Relay
R18 & R19 - Resistors to provide a minimum load current

The heart of the power section is a Magnetic Amplifier. For a detailed discussion of Magnetic Amplifiers, refer to Storm's book of the subject*. The AC coils of the Magnetic Amplifier may be considered to act as "gates" which will open at some time during the half cycle in which CR3 conducts.

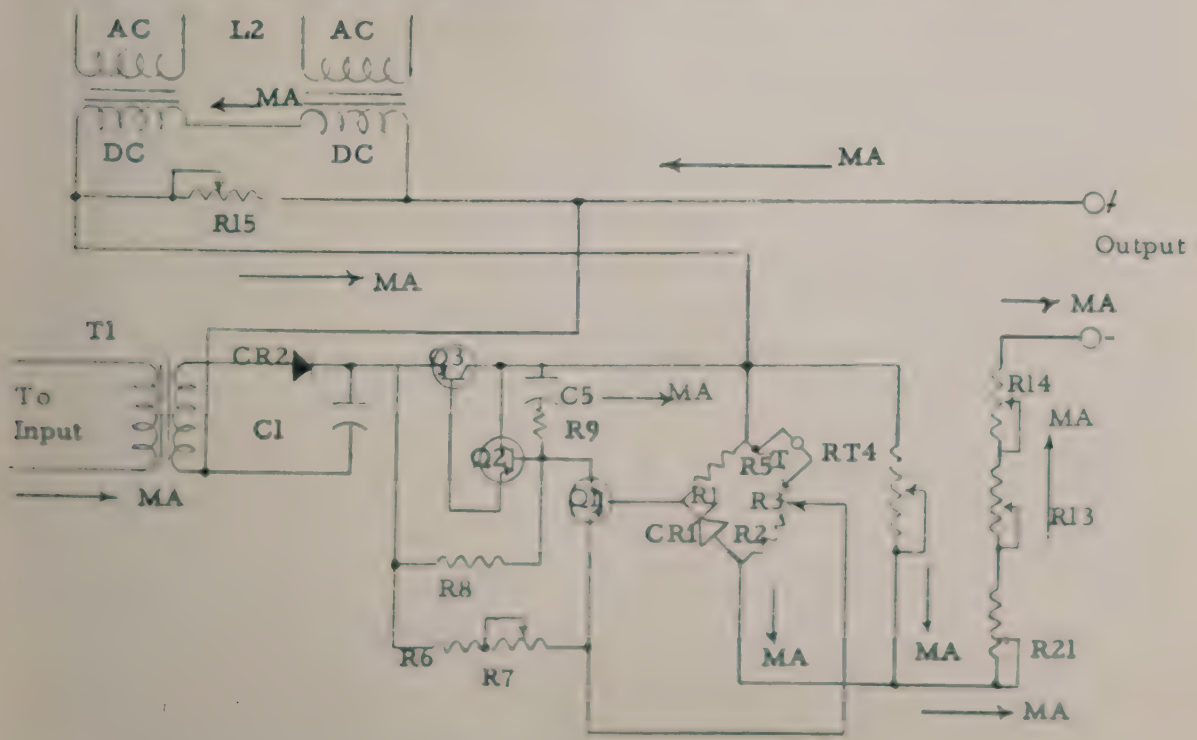
*
Storm, H. F., "Magnetic Amplifiers", John Wiley & Sons, Inc., New York, New York, 1955.

When the "gate" opens, current will flow, the average of which will be dependent upon the fraction of the half cycle period that the "gate" is open. This fraction of the half cycle period is controlled by the current in the DC winding of the Magnetic Amplifier. Since the amplifier is of a self-saturating type, a high output is obtained with no current in the DC winding. Increasing the current in the DC winding increases the control ampere turns which will either increase or decrease the output current. The points of operation which is determined by the output of the Nobatron at the time the change occurs, determines whether the current will increase or decrease with an increase in ampere turns.

The remainder of the power circuit consists of a step-down transformer, center-tapped full wave rectifier, and a filter section.

CONTROL CIRCUIT

The Control Circuit ("Power Reference") consists of a series transistor voltage regulator. The output of the Nobatron is compared directly to the reference through the control winding of the Magnetic Amplifier L2. Any change in the output due to line or load variation produces an "error" voltage across the control winding. This voltage causes a current flow which changes the firing point of the Magnetic Amplifier, thus correcting for the change in output. The degree of correction, and hence the regulation accuracy is determined; by the gain of the Magnetic Amplifier's core, its windings, and the regulation accuracy of the "Power Reference" itself.



T1 - Booster Current Power Transformer
C1 - Filter Capacitor for Booster Current Circuit
CR2 - Power Rectifier for Booster Current Circuit

L2 - Magnetic Amplifier
R15 - Anti-hunt Resistor in Shunt with the DC section of L2

R13 & 14 Output Voltage Adjustment Potentiometer (Front Panel)
R11 & 21 Bleeder Resistors for Reference Bridge

CR1 - Reference (Zener) Diode
R1 - Dropping Resistor for CR1
R2&3 - Voltage divider Resistor & Potentiometer
RT4 & R5 Temperature Compensating Resistors

R 6&7 - Line Compensating Resistor & Potentiometer

Q1 & 2 - Transistor Amplifiers
Q3 - Series Passing (Power) Transistor
R8 - Bias Resistor for Q1
R9 & C5 Oscillation Suppression RC Network

Bleeder Network

Adjustable resistor R11 & R21 together with the output voltage adjustment potentiometers R13 and 14 form a high current bleeder network with R2 and 3. Their purpose is to insure that the power reference is always loaded, despite negative current being drawn by the control coil. If the control coil current becomes larger than the current provided by the bleeder network, the transistor reference will go out of regulation, and the output voltage will rise.

Transistor Circuit

The transistor circuit operates as follows: The DC (+/-) voltage is taken from the (+/-) output of the Nobatron plus the booster supply consisting of T1, CR2 & C1. The negative return of this output goes directly to the negative (-) output of the Nobatron. Transistor Q3 is connected between the positive output of the rectifier CR2 and the positive output of the reference bridge. This transistor serves as a variable impedance which controls ; the output voltage. The impedance is varied by the transistor amplifiers Q1 & 2 which control the base current of Q3. The first amplifier stage, Q1, is controlled by the reference bridge consisting of CR1, R1-5.

A typical operation sequence is as follows: An output voltage variation is detected between the base and emitter of Q1, since Q1 is at a fixed potential above the negative output terminal due to the action of CR1. For example, suppose the output should tend to go more positive. Normally, the emitter is slightly negative with respect to the base. The positive action would tend to make the emitter less negative with respect to the base due to the action of the

resistor network R2-5, 13 & 14. In lowering the Q3 base to emitter voltage, the transistor collector current will be reducing the base currents of Q1 & 2. Lowering the base current of Q3 results in a higher impedance between the emitter and collector of Q3, which in turn results in a reduction of output voltage, hence regulation.

Reference Bridge

The silicon diode CR1 is operated in its zener or reverse current region. Under this condition, a constant voltage will appear at the terminals of the diode as the current varies within certain limits. CR1 forms one arm of a bridge circuit consisting of R1, R2, R3, R5 & RT4 arranged so that any change in the output voltage will result in change in the emitter circuit of Q1. (Refer to the schematic on Page 10)

V. MAINTENANCE AND REPAIR

MAINTENANCE

During normal life these instruments require no maintenance other than the care afforded similar equipment. It is suggested that excessive dust, etc. be removed periodically exercising care to prevent damage by cleaning tools or excessively strong air blasts.

SPARE PARTS

All components used in these instruments are of a good commercial grade and can be expected to give a reasonably long period of trouble free service. As the age of the instrument increases, some components are likely to deteriorate. We suggest that you note those items asterisked on the Parts List, which we recommend be kept on hand.

In the event it becomes necessary to replace any part, we strongly suggest that the replacement parts be of the same value as the original. Substitute parts should not be used unless we assure you that the substitute part will not impair the performance of your instrument.

REPAIR

CAUTION: DANGEROUS VOLTAGES EXIST IN THESE INSTRUMENTS. PLEASE OBSERVE APPROPRIATE PRECAUTIONS.

Trouble Shooting Chart

Symptom	Cause	Procedure for Repair
No Output Voltage	Input Fuse Blown	Replace fuse
	Breaker SW1 tripped	Reset
	Open Power Circuit	Check T2 power windings and volt. Check T3 voltage Check CR3, 4, L1, or Ammeter
High Output Voltage	Control Circuit Failure	Check control circuit per schematic for test voltages. Typical causes could be failure of Q1-Q3, CR2, C1, T1 or T2.
Low Output Voltage	Control Circuit Failure	Check control circuit per schematic for test voltages. Typical causes could be failure of CR1, or Q1-Q3 shorted emitter to collector.
High Ripple	Filter Circuit Failure	Check capacitors C2&3, L1.
Poor Regulation	Failure of CR1	Check or replace diode CR1
	Failure of Line Compensation	Adjust Potentiometer R7 Check R6
Periodic Oscillation (hunt)	Excessive high gain in T2	Adjust resistor R15 in parallel with T2 control winding. Chec & adjust R6 and 7, R9 & C5.
Unable to obtain full range of output voltage adjust	Misalignment of adjustment	High end - adjust slider on R11 Low end - adjust R3

Typical Voltage Measurements

Typical circuit voltages are shown below. All DC voltage measurements should be taken with a 20,000 ohms per volt meter. Readings should be taken at 115VAC input, nominal output voltage and one-half rated current.

Components	MR36-15	MR36-30	MR150-7.5
T1 - Term. 3 & 5	4.7VAC	4.7VAC	4.7VAC
T2A & B Term. 1 & 3	85VAC	85VAC	85VAC
T3- Term. 3 & 4	16.5VAC	16.5VAC	66VAC
Term. 4 & 5	16.5VAC	16.5VAC	66VAC
C1 (across)	4.7VDC	4.7VDC	4.7VDC

Components	MR36-15	MR36-30	MR150-7.5
CR1 (across)	3.8VDC	3.8VDC	3.8VDC
Q1 E to B	0.15VDC	0.15VDC	0.15VDC
C to B	5.3VDC	5.3VDC	5.3VDC
Q2 E to B	0.17VDC	0.17VDC	0.17VDC
C to B	4.9VDC	4.9VDC	4.9VDC
Q3 E to B	0.22VDC	0.22VDC	0.22VDC
C to B	5.1VDC	5.1VDC	5.1VDC
Q3 Ic	130MADC	130MADC	130MADC
R11 (across)	4.1VDC	4.1VDC	4.1VDC

Replacement Parts List

Model MR36-15

Listed below are all the components used in this instrument, together with their functions and part numbers.

Reference to the schematic diagram furnished with this manual will give the position of each component in the circuitry.

Schematic Symbol	Description	Function	Sorensen Part No.	Specifications
R1	Resistor 330 OHMS, 1W	CR1 Dropping Resistance	27-291	Allen Bradley GB3311
R2	Resistor 47 OHMS, 1W	Bridge Resistor	27-202	Allen Bradley GB4701
R3	Pot. 20 OHMS, 2W	Power Reference Output Adjustor	29-217	I. R. C. W20
RT4	Resistor 6.1 OHMS N. T. C.	N. T. C. Resistor	28-530	Keystone Carbon Co.
R5	Resistor 5.6 OHMS, 1/2 W.	N. T. C. Shunt Resistor	28-534	I. R. C. Type BW1/2
R6	Resistor 1K OHM, 1W	Bias Resistor	27-297	Allen Bradley GB1025
R7	Pot. 5K OHM, 2W	Compensating Potentiometer	29-220	I. R. C. Type W 2000
R8	Resistor 220 OHMS, 1W	Bias Resistor	27-205	Allen Bradley GB2211
R11	Resistor 25 OHMS, 10W Adj.	Reference Load Resistor	27-512	Ward Leonard 10A
R13	Pot. 125 OHMS, 25W	Coarse Adjustor	29-222	(Ganged Pot. Ass'y)
R14	Pot. 3 OHMS, 4W	Fine Adjustor	29-218	Clarostat Per SB29-218
R15	Resistor 5 OHMS, 10W Adj.	Anti-Oscillation Adjustor	27-504	Ward Leonard 10A
R18	Resistor 4 OHMS, 25W	Load Resistor	27-747	Ward Leonard 25F4
R19	Pot. 20 OHMS, 100W	Variable Load Resistor	29-222	OHMITE Per SC29-218
R20	Resistor 1 K 3 W	Timing Resistor for K2	28-541	Ward Leonard 3X1000
C1	Cap. 2000 mfd. 6V	Filter Capacitor	24-478	Sangamo Elec. Co.
C2	Cap. 4000 mfd. 50 V. D. C.	Input Filter Capacitor	24-413	Cornell Dubilier FB 5040
C3	Cap. 4000 mfd. 50 V. D. C.	Output Filter Capacitor	24-413	Cornell Dubilier FB 5040
C4	Cap. 8 mfd. 500 V. D. C.	Timing Capacitor	24-429	Sprague UT 85
* CR1	Rectifier, 1 N 467	Zener Reference Diode	26-953	National Semi-Conductor
CR2	Rectifier, 1 N 10818	Power Reference Rectifier	26-983	Sarkes Tarzian Type 10M
CR3	Rectifier, Selenium	Mag. Amp Rectifier	26-088	Per SB 26-088
CR4	Rectifier, Silicon	Power Rectifier	26-990	Westinghouse 303 C
CR5	Rectifier	K2 Rectifier	26-046	Per SB 26-046
* Q1	Transistor, 2N228	1st Amp. stage	18-015	Sylvania Per SB18-015
* Q2	Transistor, 2N65	2nd Amp. stage	18-012	Tung-Sol Elec. Per SB18-
* Q3	Transistor, 2N242	Passing stage	18-016	Sylvania Per SB18-016
T1	Control Trans.	Control Trans.	126-1268	Sorensen & Company, Inc.

Schematic Symbol	Description	Function	Sorensen Part No.	Specifications
T2	Power Trans. Rectifier		126-1713	Sorensen & Co., Inc.
L1	D. C. Choke		127-1318	Sorensen & Co., Inc. /
L2	Power Reactor		127-1319	Sorensen & Co., Inc.
A	Ammeter 0-20 A. D. C.	Ammeter	94-167	Marion Elect. Inst. Co. Model MM-3
V	Voltmeter 0-40, V. D. C.	Voltmeter	94-256	Marion Elect. Inst. Co. Model MM-3
K1	Heinemann Circuit Breaker		92-264	Heinemann Cat. #40-439
K2	Relay	Time Delay Relay	92-146	Allen Control Co. Type POX 195
* F1	Fuse 15 AMP. 250 V. 3 AB		42-429	Littelfuse 314015
	Fuseholder 3 AG.		42-459	Bussman ABC-15
DS1	Pilot Lamp		42-301	G. E. NE51

Replacement Parts List

Model MR36-30

Listed below are all the components used in this instrument, together with their functions and part numbers.

Reference to the schematic diagram furnished with this manual will give the position of each component in the circuitry.

Schematic Symbol	Description	Function	Sorensen Part No.	Specification
R1	Res. 330 OHMS 1W	CR1 Dropping Resistance	27-291	Allen Bradley GB3311
R2	Res. 68 OHMS 1W	Bridge Resistor	27-281	Allen Bradley GB 6801
R3	Pot. 20 OHMS 2W	Power Ref. Output Adjustor	29-217	I.R.C. W20
R4	N.T.C. Button Res. 1 W	N.T.C. Resistor	28-530	Keystone Carbon Co. L-6606-2.5-59
R5	Res. 5.6 OHMS 1/2W	N.T.C. Shunt Resistor	28-534	I.R.C. Type BW1/2
R6	Res. 1K OHM 1W	Bias Resistor	27-297	Allen Bradley GB1025
R7	Pot. 5K OHM 2W	Compensating Potentiometer	29-209	Chicago Tel. Co. 95CV
R8	Res. 220 OHMS 1W	Bias Resistor	27-512	Allen Bradley GB 2211
R11	Res. 50 OHMS 10W	Reference Load Resistor	27-513	Ward Leonard 10A
R13	Pot. 125 OHMS 25W	Coarse Adjustor	29-216	OHMITE #0152
R14	Pot. 3 OHMS 4W	Fine Adjustor	29-218	Clarostat CM 8485
R15	Res. 10 OHMS 10W	Anti-Oscillation Adjustor	27-506	Ward Leonard 10A
R18	Res. 2 OHMS 50W	Load Resistor	27-804	Ward Leonard 50A
R19	Pot. 12 OHMS 150W	Variable Load Resistor	29-215	Mallory 15 OK12P
R20	Res. 1K OHMS 3W	Timing Resistor for K2	28-541	Per A-28-541
C1	Cap. 2000 mfd. 6V	Filter Capacitor	26-478	Sangamo MTH
C2 (A-F)	Cap. 4,250 mfd. 50 V.D.C.	Input Filter Capacitor	24-479	Sangamo DCM
C3	Cap. 10,000 mfd. 50 V.D.C.	Output Filter Capacitor	24-480	Sangamo DCM
C4	Cap. 8 mfd. 500 V.D.C.	Timing Capacitor	24-429	Sprague UT 85
C5	Cap. .01 mfd. 400V	Anti-Oscillation Capacitor	24-190	Sprague 96P1035452
CR1	Diode Silicon 1N467	Zener Reference Diode	26-953	Nat'l Semi-Conductor Prod. A3B
CR2	Rect. Silicon 1N1081	Power Reference Rectifier	26-983	Sarkes Tarzian 10M
CR3 A-B	Rect. Selenium	Power Reference Rectifier	26-089	Per. SB26-089
CR4	Rect. Silicon TR152	Mag. Amp Rectifier	26-986	Per SB 26-986
CR5	Rect. Selenium	Power Rectifier	26-046	Per SB26-046

Schematic Symbol		Description	Function	Sorensen Part No.	Specifications
*Q1		Transistor	1st Amp stage	18-015	Sylvania 2N228
*Q2		Transistor	2nd Amp stage	18-012	Tung-Sol 2N65
*Q3		Transistor	Passing stage	18-016	Sylvania 2N242
T1		Control Transformer	Control Trans.	126-1685	Sorensen & Co., Inc.
T2		Rect. Input Trans.		126-1686	Sorensen & Co., Inc.
L1		DC Choke		127-1300	Sorensen & Co., Inc.
L2	A-B	Power Reactor		127-1301	Sorensen & Co., Inc.
K1		Relay		92-146	Per SC92-146
K2		Circuit Breaker		92-262	Heinemann Per SB92-262
A		Ammeter 0-40 ADC	Ammeter	94-163	Marion MM3
V		Voltmeter 0-10, 0-20, 0-40	Voltmeter	94-264	Marion MM3
S1		Switch		45-017	Central lab 1467
*F1		Fuse 30 amp		42-824	Bussman BAF30
		Fuse Holder 4AG		42-464	Bussman HKP-H
PL1		Pilot Lamp		42-301	G. E. 51
		Pilot Lamp Holder		42-369	E. F. Johnson 147-1144-4

Replacement Parts List

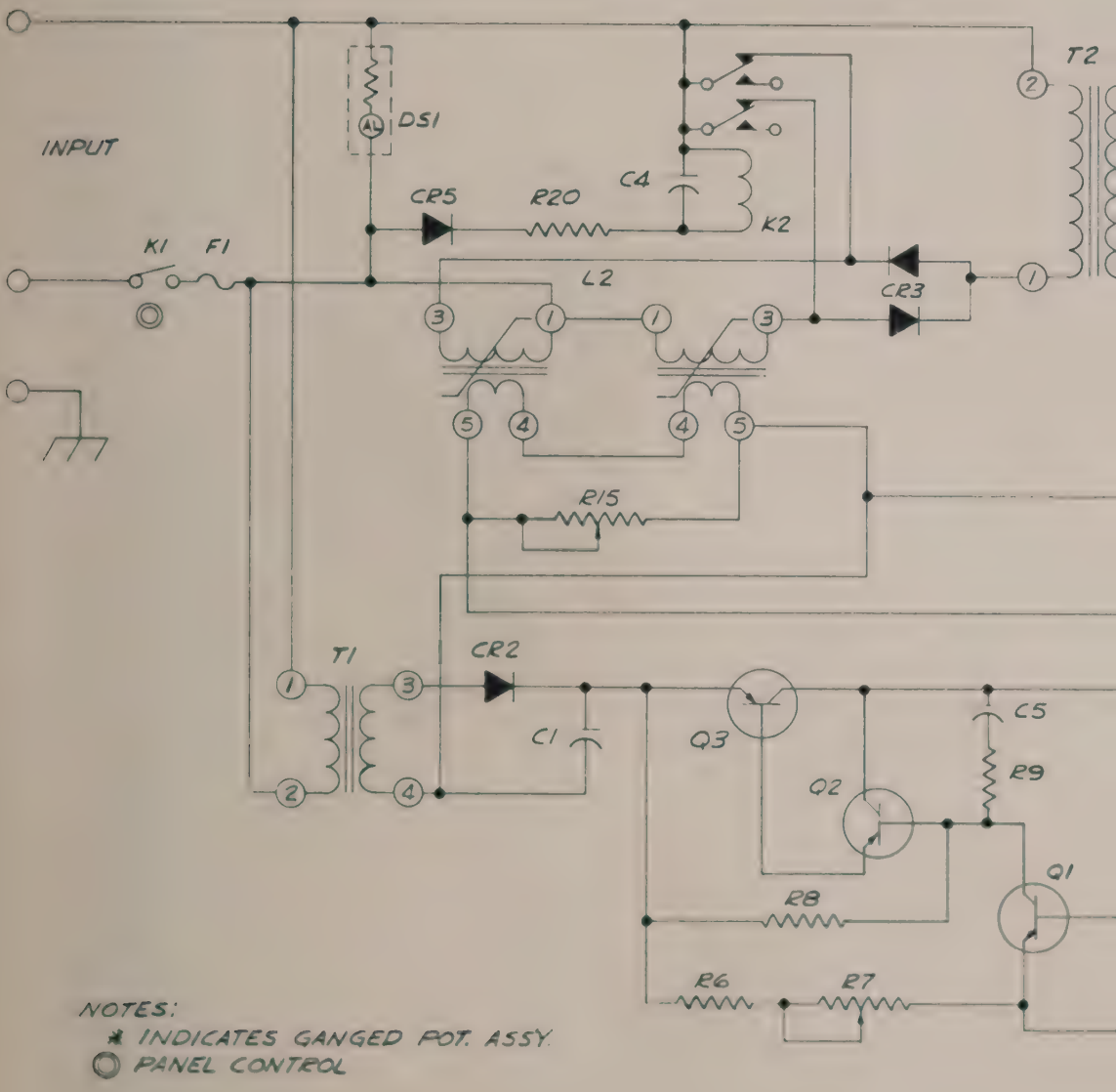
Model MR150-7.5

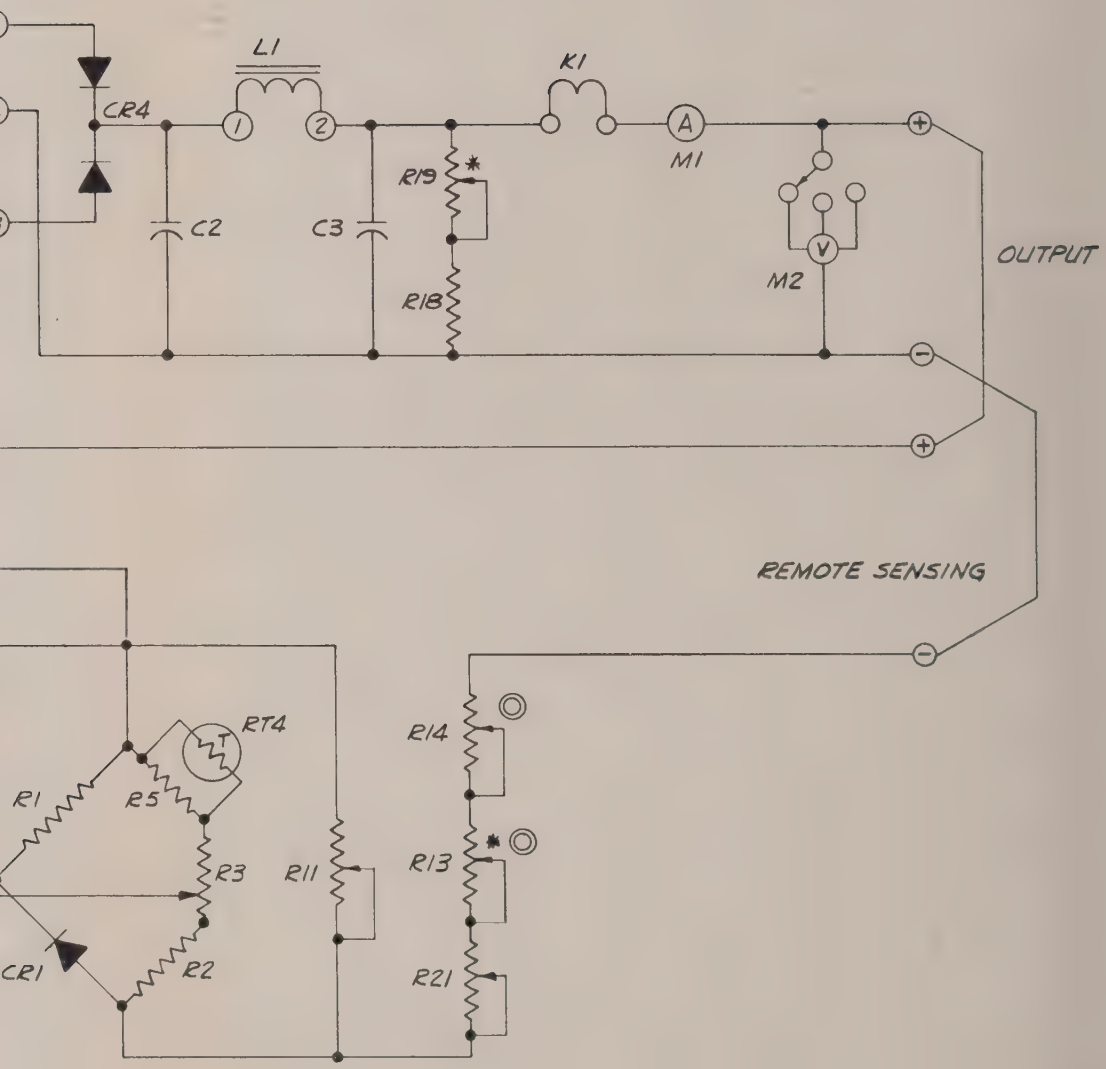
Listed below are all the components used in this instrument, together with their functions and part numbers.

Reference to the schematic diagram furnished with this manual will give the position of each component in the circuitry.

Schematic Symbol	Description	Function	Sorensen Part No.	Specifications
R1	Res. 330 OHMS 1W	CR1 Dropping Resistance	27-291	Allen Bradley GB3311
R2	Res. 47 OHMS 1 W	Bridge Resistor	27-202	Allen Bradley GB 4701
R3	Pot. 20 OHMS 2W	Power Reference Output Adjustor	29-217	I. R. C. W20
R4	N. T. C. Button Res. 1W	N. T. C. Resistor	28-530	Keystone Carbon Co. L-6606-2. 5-59
R5	Res. 5. 6 OHMS 1/2W	N. T. C. Shunt Resistor	28-534	I. R. C. BW 1/2
R6	Res. 1K OHM 1W	Bias Resistor	27-297	Allen Bradley GB1025
R7	Pot. 5K OHM 2W	Compensating Potentiometer	29-220	I. R. C. W 5000
R8	Res. 220 OHMS 1W	Bias Resistor	27-205	Allen Bradley GB2211
R9	Res. 100 OHM 1/2W		27-173	Allen Bradley EB 1011
R11	Res. 50 OHMS 10W	Reference Load Resistor	27-513	Ward Leonard 10A
R13	Pot. 500 OHMS 50W	Coarse Adjustor	29-238	Ohmite #0324
R14	Pot. 10 OHMS 4W	Fine Adjustor	29-240	Clarostat Series 10
R15	Res. 10 OHMS 10W	Anti-Oscillation Adjustor	27-506	Ward Leonard 10A
R18	Res. 32 OHMS 50W	Load Resistor	27-896	Ward Leonard550F32
R19	Pot. 150 OHMS 150W	Variable Load Resistor	29-239	Mallory 150K 150P
R20	Res. 1K OHMS 3 W	Timing Resistor for K2	28-541	Per A-28-541
R21	Res. 100 OHM 10W, Output Range Limiting		27-515	Ward Leonard 10A
C1	Cap. 2000 mfd. 6V	Filter Capacitor	24-478	Sangamo MTH
C2 (A-E)	Cap. 650 mfd. 250V. D. C.	Input Filter Capacitor	24-717	Per SC24-717
C3	Cap. 650 mfd. 250 V. D. C.	Output Filter Capacitor	24-717	Per SC24-717
C4	Cap. 8 mfd. 500 V. D. C.	Timing Capacitor	24-429	Sprague UT 85
C5	Cap. 01 mfd. 200 V	Anti-Oscillation Adjustor	24-190	Astron ML-2-01
*CR1	Diode Silicon 1N467	Zener Reference Diode	26-953	Nat'l Semi-Conductor Prod. A3B

Schematic Symbol	Description	Function	Sorensen Part No.	Specifications
CR2	Rect. Silicon 1N1081	Power Reference Rectifier	26-983	Sarkes Tarzian 10M
CR3 A-B	Rect. Selenium	Mag. Amp Rectifier	26-089	Per SB26-089
CR4 A-B	Rect. Silicon	Power Rectifier	26-815	Per A26-815
CR5	Rect. Selenium	K2 Rectifier	26-046	Per SB26-046
* Q1	Transistor	1st Amp stage	18-015	Sylvania 2N228
* Q2	Transistor	2nd Amp stage	18-012	Tung-Sol 2N6 5
* Q3	Transistor	Passing Stage	18-019	Tung-Sol 2N242
T1	Control Transofrmer	Control Trans.	126-1685	Sorensen & Co., Inc.
T2	Rect. Input Trans.		126-1825	Sorensen & Co., Inc.
L1	DC Choke		127-1375	Sorensen & Co., Inc.
L2 A-B	Power Reactor		127-1377	Sorensen & Co., Inc.
K2	Relay	Time Delay Relay	92-146	Per SC92-146
M1	Ammeter 0-10 ADC	Ammeter	94-179	Marion MM3
M2	Voltmeter 0-40, 0-80, 0-200	Voltmeter	94-288	Marion MM3
K1	Circuit Breaker		92-268	Heinemann Per SB92-268
S1	Switch	Meter Switch	45-017	Central lab 1455
* F1 (5 ea.)	Fuse 30 amp		42-824	Bussman BAF30
	Fuse Holder		42-465	Bussman HPC
DS1 (2 ea.)	Pilot Lamp		42-301	G. E. NE51
	Pilot Lamp Holder		42-369	E. F. Johnson 147-1144-4


INPUT
K1
F1
DS1
CR5
R20
C4
K2
L2
CR3
T2
R15
T1
CR2
C1
Q3
Q2
C5
R9
Q1
R8
R6
R7
NOTES:
INDICATES GANGED POT. ASSY.
PANEL CONTROL



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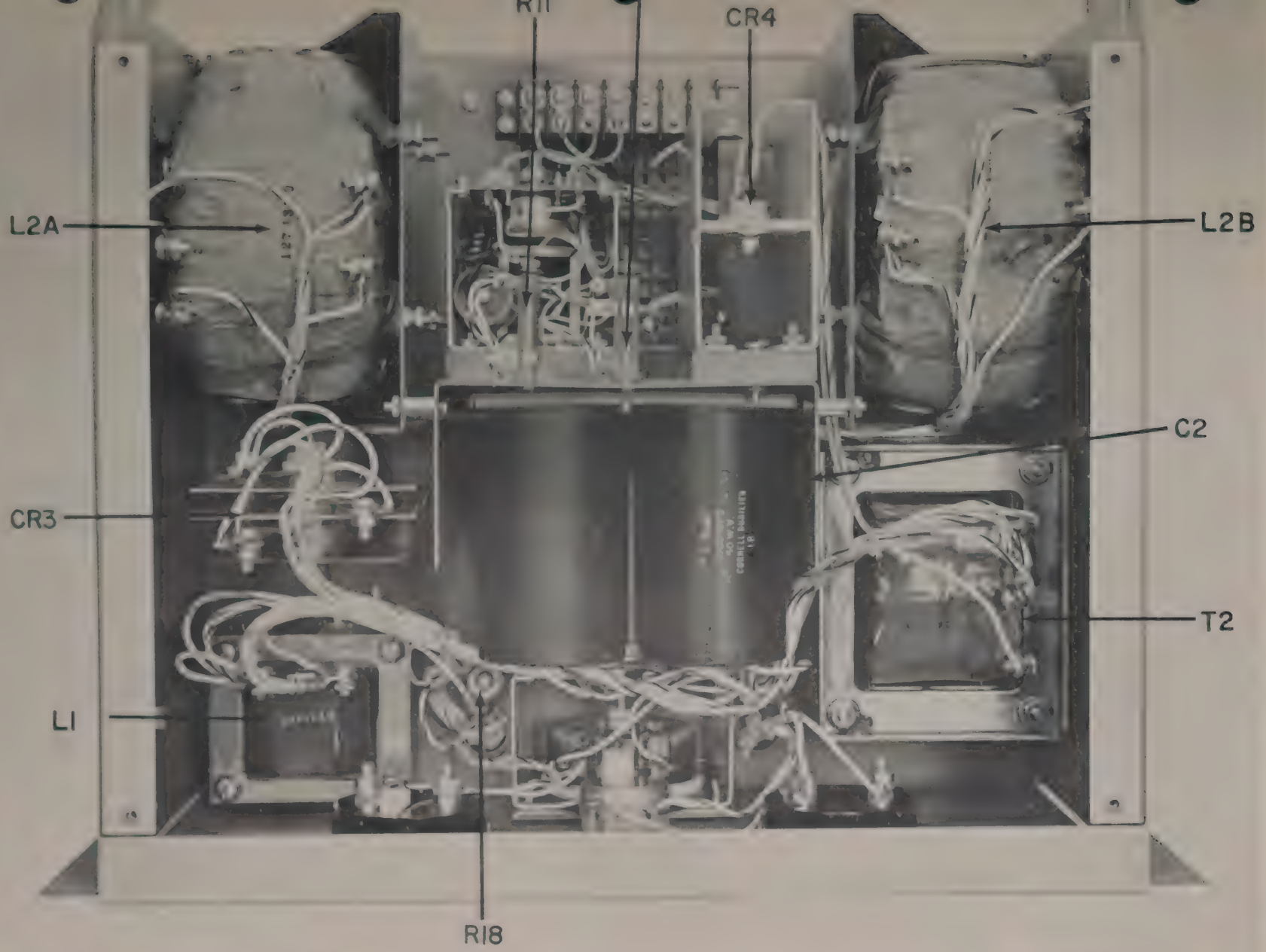
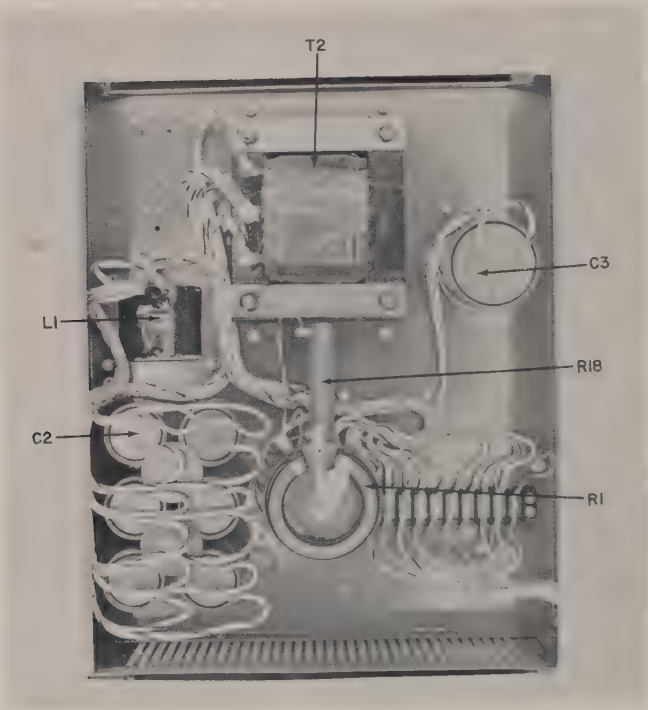


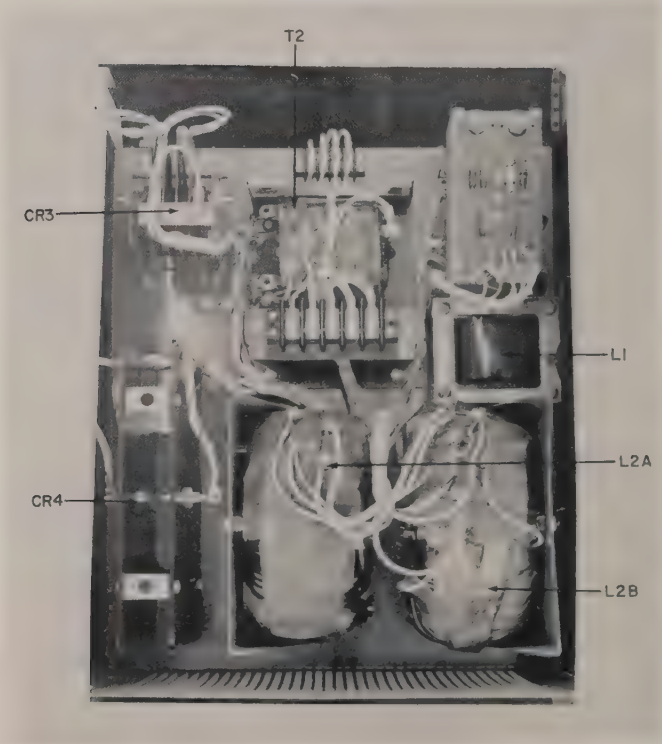
Chassis Layout Model MR 36-15

Chassis Layouts Models MR36-30 and MR150-7.5

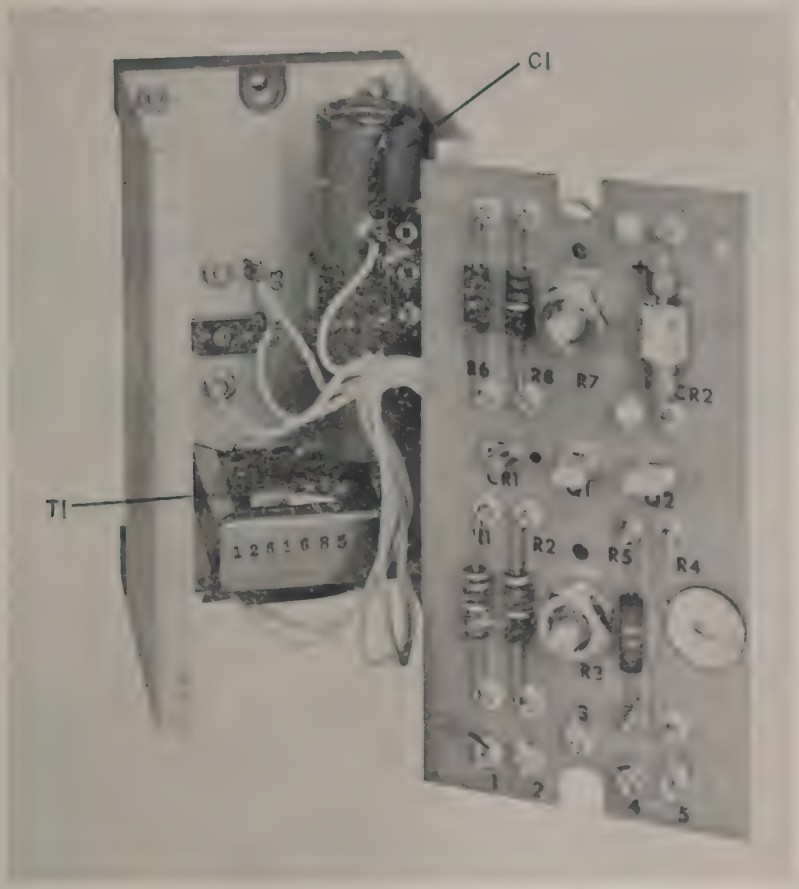
Front View

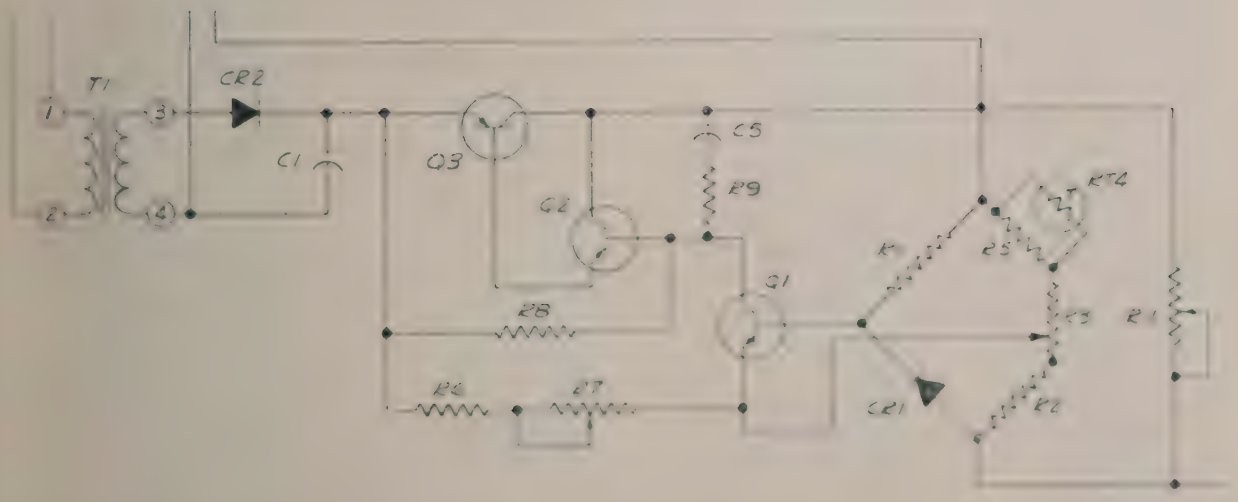


Rear View



Power Reference Component Layout and Schematic Diagram





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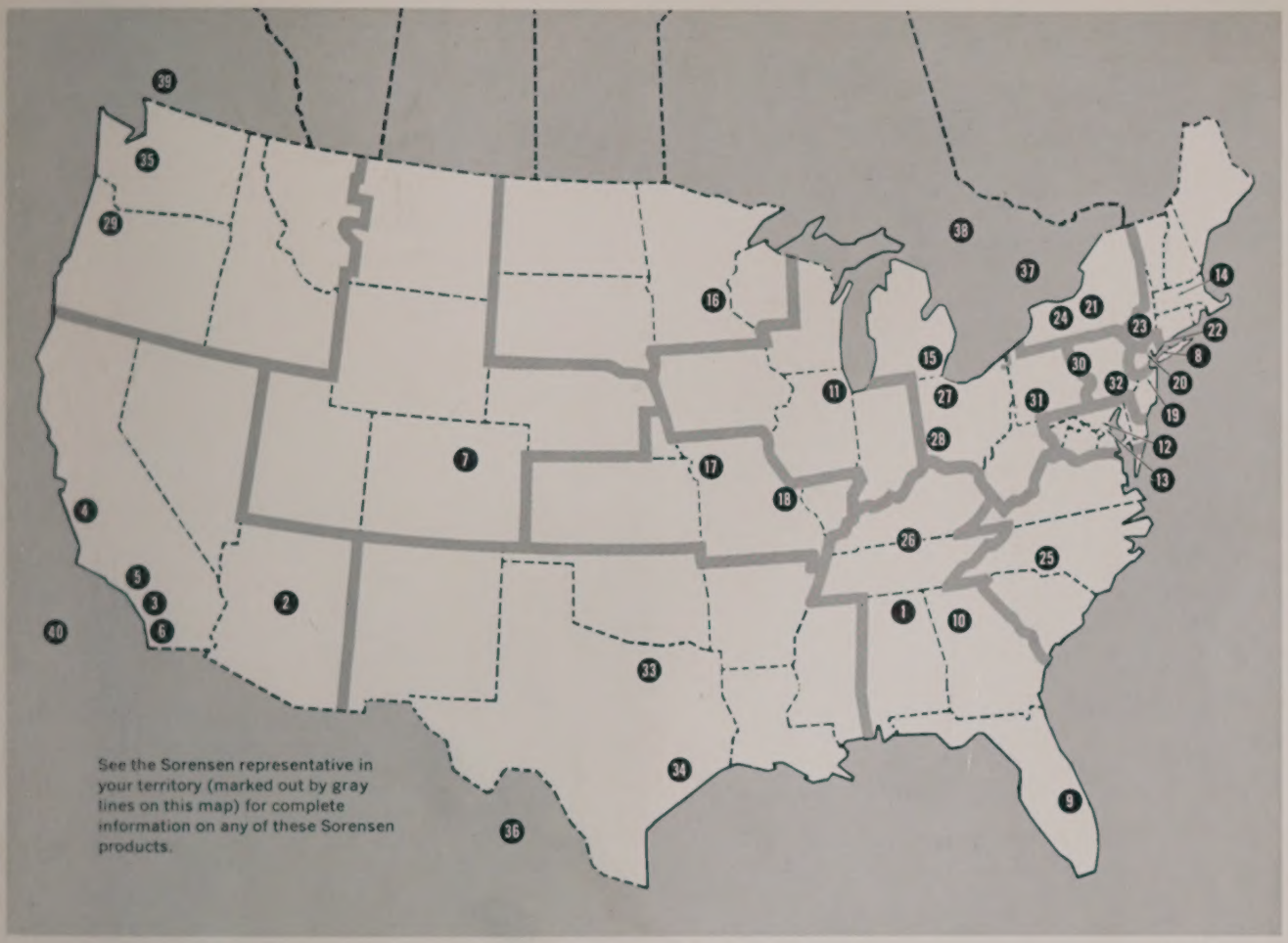
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